

Pinworms from Water Scavenger Beetles (Coleoptera: Hydrophilidae) with a Description of a New Species, *Zonothrix columbianus* sp. n. (Oxyurida: Pseudonymidae), from Western Canada

MARTIN L. ADAMSON AND ADRIENNE BUCK

Department of Zoology, University of British Columbia, Vancouver, British Columbia, Canada V6T 2A9

ABSTRACT: *Zonothrix columbianus* sp. n. (Oxyurida: Pseudonymidae) is described from hydrophilid beetles in the lower mainland of British Columbia, Canada. The new species most closely resembles *Zonothrix adversa* in body shape, in having irregularly inflated annules in the cervical region, and by the shape of the female tail. It is distinguished by its shorter tail, the greater distance between the vulva and anus (20–28% of body length in the new species compared with 12–15% in *Z. adversa*), and by its longer spicule. The new species occurred in 172 of 211 *Tropisternus columbianus*, 3 of 5 *Tropisternus lateralis marginatus*, and 2 of 8 *Hydrobius fuscipes*.

KEY WORDS: pinworms, Oxyurida, entomophilic nematodes, *Zonothrix*, new species.

The Oxyurida is a major order of zooparasitic nematodes richly represented in arthropods and vertebrates. The broad host distribution of the group belies a rather narrow ecological specificity; they are found only in hosts in which the posterior gut is modified to form a fermentation chamber. Among arthropods, oxyuridans are most common in Diplopoda, Blattoida, and Gryllotalpoidea. The vast majority of species have been reported from terrestrial hosts in tropical and subtropical regions. The present communication describes a new species of Oxyurida from hydrophilid beetles in the lower mainland of British Columbia and represents the first report of an oxyuridan from Canadian insects.

Materials and Methods

Beetles were collected from drainage ditches and ponds in the lower mainland of British Columbia using long-handled nets and transported to the laboratory in polyethylene bags. The following hosts were examined: *Tropisternus columbianus*, *Tropisternus lateralis marginatus*, *Hydrobius fuscipes*, and *Enochrus lacustris*. Dr. Ales Smetana (Biosystematic Research Centre, Agriculture Canada, Ottawa, Ontario, Canada K1A 0C6) confirmed identifications of beetles.

Beetles were placed ventral side up in stacking dishes containing a small volume of 0.60% sodium chloride solution. The abdomen was separated from the thorax using fine forceps, and the intestine removed and opened using fine dissecting needles. Nematodes were fixed in hot glycerin–ethanol and cleared in lactophenol. Drawings were made with the aid of a drawing tube.

Description

Zonothrix columbianus sp. n.

(Figs. 1–12)

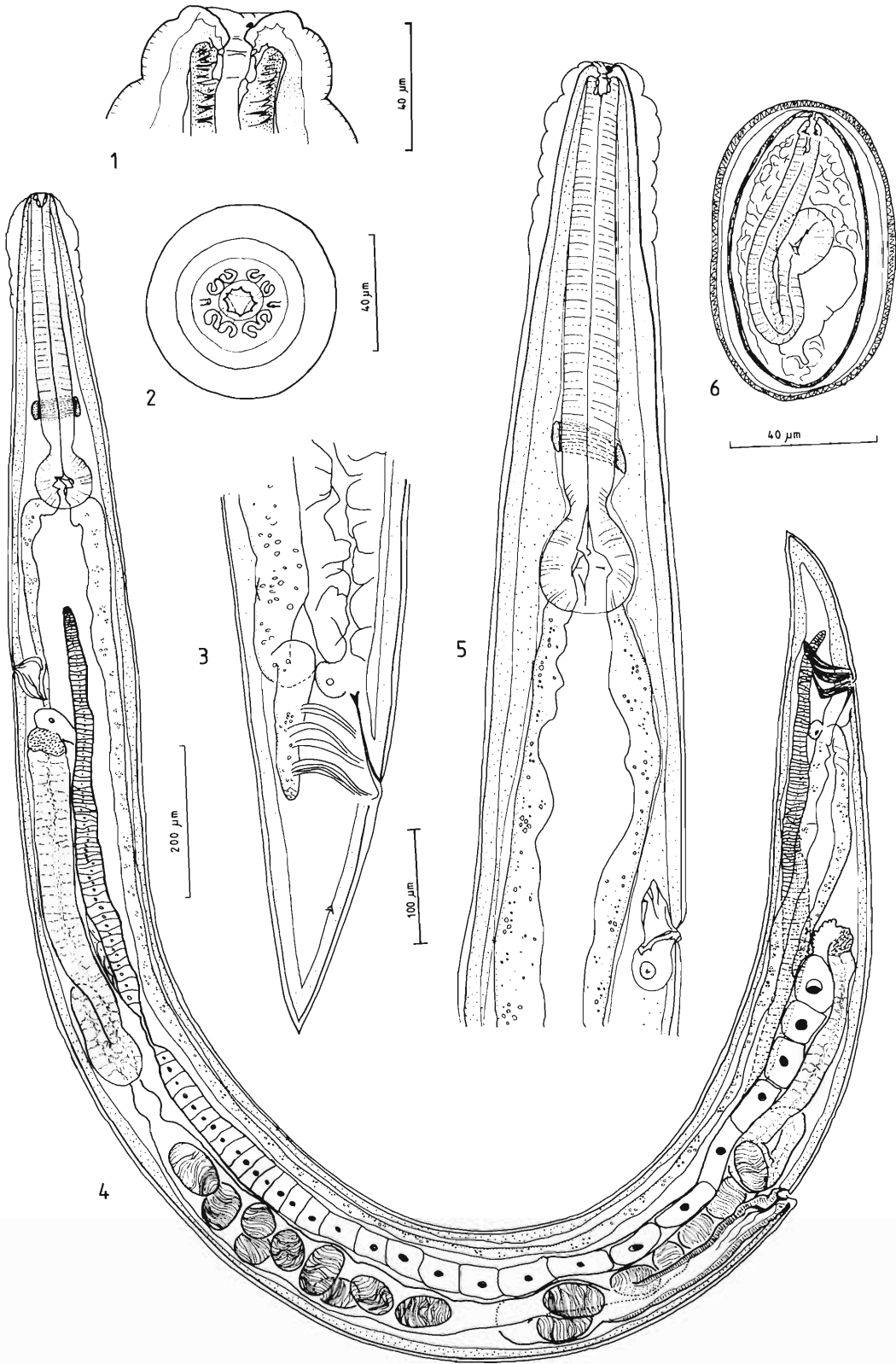
GENERAL (all measurements in μm unless otherwise stated): Oral opening polygonal with 8

submedian papillae and 2 lateral amphids. Inner papilla not observed.

MALE (range of 15 specimens, holotype in parentheses): Length 0.791–1.665 (1.463) mm. Maximum width 37–91 (67). Buccal cavity 8–14 (12) long, its posterior 4–7 (5) surrounded by esophageal tissue. Esophagus 163–255 (255) long including corpus 116–209 (197) and isthmus 16–20 (18) long, and valved bulb 27–42 (36) long and 25–42 (33) wide. Nerve ring 109–183 (183), excretory pore 200–385 (320), and anterior tip of testis 424–847 (806) from cephalic extremity.

Seven pairs of caudal papillae: 2 pairs preanal subventral; 1 pair subventral, 1 pair sublateral and 1 median duplex papillae immediately posterior to anus; 1 pair subventral and 1 pair sublateral, 7–11 (8) from caudal extremity. Spicule 23–27 (26) long. Tail roughly conical, 35–44 (35) long. Phasmids 12–21 posterior to anus.

FEMALE (range of 13 specimens, allotype in parentheses): Habitus C-shaped. Length 2.215–4.343 (4.343) mm. Maximum width 152–225 (225) near midbody. Buccal cavity 13–20 (20) long, its posterior 6–10 (10) surrounded by esophageal tissue. Body cuticle bearing faint transverse striations about 4 apart. Cuticle in cervical region inflated, forming 8–11 irregular annule-like swellings. Esophagus 365–471 (471) long including corpus 277–397 (397), and bulb 77–84 (84) long and 66–88 (88) wide. Nerve ring 250–349 (349), excretory pore 532–852 (852), anterior spermatheca 670–899 (899), vulva 2.097–3.033 (3.033) mm, and posterior spermatheca 2.457–3.794 (3.794) mm from cephalic extremity. Amphidelphic. Ovary associated with anterior uterus beginning just posterior to anus, extending anteriorly before flexing posteriorly at



spermatheca just behind excretory pore. Ovary associated with posterior uterus beginning just anterior to excretory pore, extending posteriorly and flexing anteriorly at spermatheca just anterior to anus. Oviducts coiling once before emptying into uteri. Anterior lip of vulva forming prominent projection. Tail subconical 180–303 (303) long. Phasmids 94–169 posterior to anus.

EGGS: Eggs 70–80 long and 40–45 wide, surrounded by 2 filaments originating at spherical structure on surface of eggshell. Eggs nearest vagina containing larva flexed once at midbody and once just behind tail. Larva contracting to form ovoid resting stage with thickened cuticle in eggs dissected from female and incubated for 3 days at room temperature.

Taxonomic Summary

Diagnosis

Aside from the present species, 8 species of *Zonothrix* have been described: *Z. tropisterna* Todd, 1942, from *Tropisternus nimbus* in Nebraska, *Z. hydroid* (Galeb, 1878) Todd, 1942, from *Hydrous caraboides* in Europe, and *Z. adversa* Kloss, 1958, from *Tropisternus collaris*, *Z. galebi* Kloss, 1959, from *Neohydrophilus medius*, *Z. gladius* Kloss, 1959, from *Coleostoma luederwaldi*, *Z. helochaesae* Kloss, 1959, from *Helochaes pallipes*, *Z. izecksohni* from *Tropisternus lateralis*, and *Z. paraense* Kloss, 1959, from *Tropisternus chalybeus* from Brazil. The present species most closely resembles *Z. adversa* in body shape, in having irregularly inflated annules in the cervical region, and by the shape of the female tail. The new species is distinguished by its shorter tail and by the greater distance between the vulva and anus (20–28% of body length in the new species compared with 12–15% in *Z. adversa*). The new species is further distinguished by its longer spicule.

HOLOTYPE MALE AND ALLOTYPE FEMALE: Collected from same host individual and stored in the National Museums of Canada Parasite Collection, Ottawa (NMCP 1989-0233, holotype; NMCP 1989-0234, allotype).

OTHER SPECIMENS: The following material was collected from the type host and locality. Na-

tional Museums of Canada Parasite Collection, Ottawa (NMCP 1989-0235, 0236, 0238, 0240, males; NMCP 1989-0237, 0239, 0241, females). United States National Museum Parasite Collection, 4 vials, each with 1 male and 1 female (USNM 80860). Laboratoire de Zoologie (Vers), Museum national d'Histoire naturelle, Paris (Bocal N568: 63 HF-C 307, 64 HF-C 285, 65 HF-C 286).

HOSTS: *Tropisternus columbianus* (type host); *T. lateralis marginatus*, *H. fuscipes* (Hydrophilidae; Coleoptera) (Table 1).

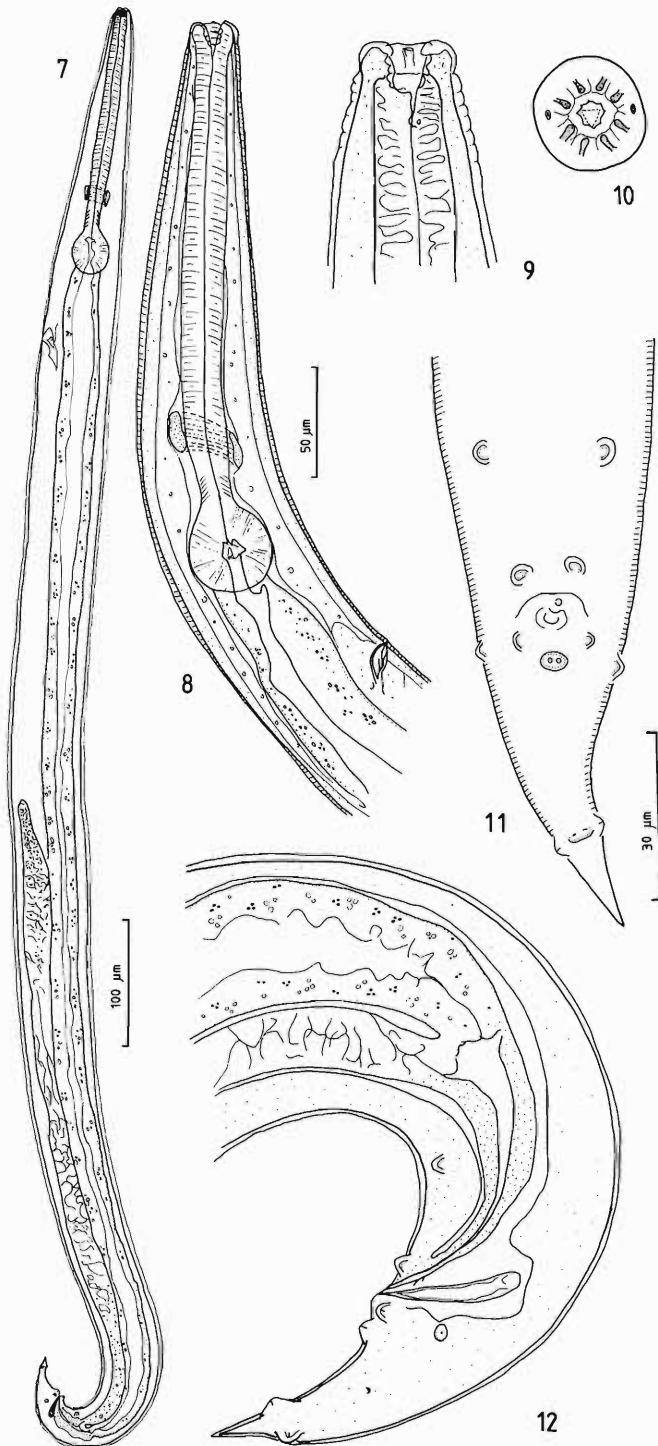
LOCATION IN HOST: Worms were located just behind the level at which the Malpighian tubules enter the posterior gut and were oriented with their anterior extremities facing toward the midgut.

LOCALITY: Drainage ditches surrounding the Southlands Riding Stables, Vancouver, British Columbia, Canada (type locality); retention ponds of the Little Campbell River System, Whiterock, British Columbia, Canada.

Remarks

The Oxyurida parasites of Hydrophilidae are a well-defined clade characterized by having 7 pairs of caudal papillae in the male and spiral filaments on the eggshell. The first species described was *Pseudonymus spirotheca* (Gyory, 1856) Diesing, 1857 (= *Oxyuris spirotheca* Gyory, 1856, and *Ptychocephalus spirotheca* (Gyory, 1856) Diesing, 1860, from *Hydrous piceus* in Austria. Galeb's (1878) *Oxyuris (Helicothrix) spirotheca*, also from *H. piceus* in Europe, is not conspecific with Gyory's material. Kloss (1959) renamed it *Gyoryia europea*, type species of *Gyoryia* Kloss, 1959, but Leibersperger (1960) and Jarry (1964) consider it a synonym of *Pseudonymus islamabadi* (Basir, 1941) Basir, 1956. The first suprageneric taxon proposed for the group was Kloss' (1959) subfamily Gyoryiinae. However, because there is disagreement as to the validity of *Gyoryia*, Adamson (1980, 1989) proposed the Pseudonymiinae and Pseudonymidae for these worms. The following genera are referable to the family: *Pseudonymus* Diesing, 1857, *Zonothrix* Todd, 1942, *Stegonema* Travassos,

Figures 1–6. *Zonothrix columbianus* sp. n., female. 1, 2. Cephalic extremity in lateral and apical views (scale = 40 μ m). 3. Caudal extremity (scale = 100 μ m). 4. Entire worm, lateral view (scale = 200 μ m). 5. Esophageal region, lateral view (scale = 100 μ m). 6. Egg containing infective larva after 4 days of incubation at 22°C; filaments on the egg shell are not depicted (scale = 40 μ m).



Figures 7–12. *Zonothrix columbianus* sp. n., male. 7. Entire worm, lateral view (scale = 100 µm). 8. Esophageal region, lateral view (scale = 50 µm). 9, 10. Cephalic extremity in lateral and apical views (scale = 30 µm). 11, 12. Caudal extremity in ventral and lateral views (scale = 30 µm).

Table 1. Prevalence (% of hosts infected) and intensity (number of worms per infected host) of *Zonothrix columbianus* in 4 species of Hydrophilidae (Coleoptera) from the lower mainland of British Columbia, Canada.

Host	Number exam- ined	Number infected (%)	Inten- sity (range)
<i>Tropisternus columbianus</i>	211	172 (82)	1-7
<i>T. lateralis</i>	5	3 (60)	2-3
<i>Hydrobius fuscipes</i>	8	2 (25)	1-2
<i>Enochrus lacustris</i>	14	0 (0)	N/A

1954, *Gyoryia* Kloss, 1957, *Itaguaina* Kloss, 1959, and *Jarryella* Van Waerebeke and Remillet, 1973. Genera are distinguished on the basis of vulvar position and the form of cuticular annulations in the cervical region of the female.

Zonothrix Todd, 1942, was proposed to accommodate *Z. tropisterna* and was distinguished from its most closely related genus *Pseudonymus* in lacking inflated cervical annules and by the posterior position of the vulva. In fact, some *Zonothrix* spp. do have inflated annules but they are discontinuous and irregular in number and size; those of *Pseudonymus* spp. form a complete ring around the cervical region although they appear to vary in size and number (Jarry, 1964).

Only 1 of the 9 species of *Zonothrix* has been described outside of the New World, namely *Z. hydroi*, described by Galeb (1878). This species has not been redescribed and is considered a species inquirenda by Jarry (1964). Of the remaining species, 6 occur in Brazil and 5 are parasites of members of the genus *Tropisternus*.

In the following key to the species, zoogeographic localities and hosts are included as ancillary information; they are not considered key characters;

- 1(16). Body of female C-shaped after fixation. Maximum width greater than 5% total length.
- 2(3). Posterior end of corpus in female swollen, almost as broad as esophageal bulb. Ex: *Hydrous caraboides* in France *Z. hydroi*
- 3(2). Posterior end of corpus in female much narrower than bulb.
- 4(5). Mature female less than 2.0 mm long. Ex: *Helochares pallipes* in Brazil *Z. helocharesae*
- 5(4). Mature female 3.0 mm or larger.
- 6(15). Swollen annulations present in cephalic extremity of female.
- 7(8). Tail of female narrowing abruptly behind

- anus and continuing as spinelike caudal extension. Ex: *Coleostoma luederwaldi* in Brazil *Z. gladius*
- 8(7). Tail of female not as above.
- 9(12). Caudal extremity of female terminating in short spinelike structure.
- 10(11). Caudal spine of female 26-35 µm long. Ex: *Neohydrophilus medius* in Brazil *Z. galebi*
- 11(10). Caudal spine of female less than 10 µm long. Ex: *Tropisternus chalybeus* in Brazil *Z. paraense*
- 12(9). Caudal extremity of female without spine-like appendage.
- 13(14). Distance between vulva and anus 20-28% total body length. Tail of female 5-8% body length. Ex: *Tropisternus columbianus*, *T. lateralis marginatus*, and *Hydrobius fuscipes* in Canada *Z. columbianus*
- 14(13). Distance between vulva and anus less than 15% total body length. Tail of female about 10% body length. Ex: *Tropisternus collaris* in Brazil *Z. adversa*
- 15(6). Swollen cuticular annulations absent on cervical region of female. Ex: *Tropisternus nimbatius* in the United States *Z. tropisterna*
- 16(1). Body of female coiled one and a half times after fixation. Maximum width about 3.5% of total length. Ex: *Tropisternus lateralis* in Brazil *Z. izecksohni*

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